Algorithms for Genome Rearrangement
Summer 2017

Exercises

Exercise 02, 28.04.2017

1. Given permutation $\pi = (\,2\ 1\ 3\ 5\ 4\,)$,   (4 P)

    (a) calculate the reversal distance $srd(\pi)$

    (b) find a sorting scenario, i.e. a sequence of reversals $\rho_1, \cdots, \rho_d$ such that $\pi \circ \rho_1 \circ \cdots \circ \rho_d = \mathbf{id}$ and $srd(\pi) = d$.

2. Any two components of a permutation are either *disjoint*, *nested*, or *chained*, the   (4 P)
    latter meaning that they appear consecutively and share extremities of the same
    symbol/gene. A component tree of a permutation is defined as follows:

    Definition *Given a permutation π and its components, the* component tree T_π *is
    constructed as follows:*

    *(a) Each component is represented by a round node. It is colored black if unoriented
    and white, otherwise.*

    (b) Each maximal chain is represented by a square node, containing its children.

    (c) A square node is the child of the smallest component that contains the chain.

    In calculating $srd(\pi)$, the offset for additional reversals needed to orient unoriented
    components can be computed by determining a *cover* of the component tree T_π that
    has *minimum* cost.

    Definition *A* cover *C of a component tree T_π is a collection of paths joining all
    the unoriented components of π, such that each terminal node of a path belongs to a
    unique path. A path is* short *if it contains only one component, otherwise it is* long.

    The cost $t(C)$ of a cover C is the sum of costs of all paths, whereby a short path has
    cost 1 and a long path has cost 2.

    Consider permutation

    $$\pi = (\,1\ 3\ -8\ 7\ -6\ 4\ 5\ 9\ 11\ -13\ 10\ -12\ 14\ -2\ 15\ 17\ 22\ 18\ 20\ 19\ 21\ 23\ 28\ 24\ 26\ 25\ 27\ 29\ 16\,),$$

    (a) use the Java program `InversionVisualization` provided on the course website
    to draw $BG(\pi)$. You can download the file containing π here. Using $BG(\pi)$,
    construct the component tree T_π;

    (b) find an optimal tree cover (i.e. a cover with minimum cost) for T_π.

Hand in solutions before tutorial on 05.05.2017